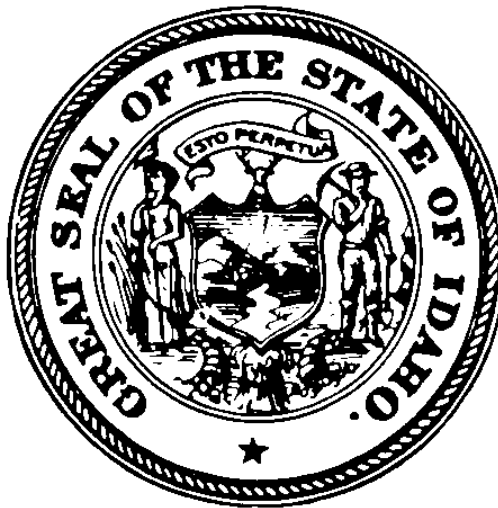


# **HAZARD MITIGATION REPORT**

Lemhi County  
and  
City of Salmon, Idaho

IDAHO DEPARTMENT OF WATER RESOURCES  
and  
IDAHO BUREAU OF DISASTER SERVICES

FEMA DR-697



## **HAZARD MITIGATION REPORT**

**LEMHI COUNTY AND CITY OF SALMON, IDAHO  
FEMA DR-697  
declared February 16, 1984**

**by  
Idaho Department of Water Resources  
and  
Idaho Bureau of Disaster Services**

March, 1985

Statehouse  
Boise, Idaho 83720

# FLOOD HAZARD MITIGATION REPORT LEMHI COUNTY AND CITY OF SALMON

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# EXECUTIVE SUMMARY

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The real intent of a hazard mitigation report is to present recommendations for improvement. The recommendations in this report follow:

## Strategy 1 Encourage Individual Mitigation Efforts

- 1.1 The city is to come into compliance with the National Flood Insurance Program immediately (now accomplished).
- 1.2 Encourage city to adopt a flood-damage reduction ordinance (now accomplished).

Encourage owners of substantially damaged structures to take advantage of minimization alternatives offered through the Small Business Administration (SBA) loan program and the Individual Family Grant program.

- A. The SBA national office should change its regulations allow floodproofing expenditures for its loan funds when the Hazard mitigation Planning Team recommends such actions. The Regional Director and the Assistant Director of the State and Local Programs and Support of the national office of the Federal Emergency Management Agency (FEMA) should pursue this recommendation this year.
  - B. Residential owners located within a floodplain should make use of the Farm Home Administration (FmHA) Home Ownership program for long-term "economic" floodproofing improvements. The Lemhi County FmHA manager should write in the near future short article for the local newspaper and prepare radio spot for local use so the availability of this program is brought to the attention of the local people.
  - C. Owners able to qualify for commercial loans should construct "economic" floodproofing measures.
  - D. The Idaho Department of Health and Welfare should change its regulations to provide floodproofing as an eligible Individual Family Grant expense if it is recommended by the Hazard Mitigation Planning Team. The Idaho Bureau of Disaster Services should pursue this recommendation with the change suggested to be made by June 1985.
  - E. The director of the Salmon Public Library should acquire floodproofing booklets by the end of June 1985. The operation and training officer for the Idaho Bureau of Disaster Services also may want to consider making some of these references available to county civil defense directors.
- 1.4 Use Idaho Community Development Block Grant (ICDBG) funds as grants and loans for individual property improvements to minimize future flood losses. (This early recommendation or some facet of it was found difficult to implement.)
  - 1.5 Provide natural ground-elevation data on maps made available to the public by FEMA. The Regional Director and the Assistant Director of State and Local Programs and Support should pursue this recommendation this year in the national office of FEMA.

## Strategy 2 Establish a High Hazard Area Designation and Integrate it into City and County Ordinances

- 2.1, 2.2 and 2.3 Develop a high hazard area designation and integrate it into city and county ordinances. (Now accomplished by the city.) The county commission is encouraged to include this high hazard area category in the updated floodplain ordinance which could be reviewed and acted upon by the end of July 1985 (see element 3.2).
- 2.4 High hazard area delineation should be incorporated into most new mapping by FEMA within urban areas, starting in Idaho. The Regional Director and the Associate Director of State and Local Programs and Support for FEMA should pursue this recommendation with the Federal Insurance Administration during 1985.

## Strategy 3 Increase Regulatory Posture of County

- 3.1 Map county flood-prone areas using existing data. (Preliminary work is completed; remaining work has been scheduled.) The county is encouraged to now use the floodplain information on the draft Flood Insurance Rate Maps to guide development within the floodplains of the county.
- 3.2 Work with the county in developing a workable floodplain management ordinance. The county commission is encouraged to adopt an updated floodplain ordinance now and not wait until the March 1986 deadline.

## Strategy 4 Remove Ice or be Prepared to Fight the Flood Caused by the Melting Ice

Elements 4.1 and 4.2 Research methods of financing ice removal (ice removal is completed).

## Strategy 5 Community-Wide Responses to Reducing Future Flood Damages are to Continue and Increase in Intensity

- 5.1 The state of Idaho, the city of Salmon and Lemhi County are to work with the Corps of Engineers in developing and implementing a solution to more permanently reduce existing property damage. The decision should be made by July 1985 on which alternative solution will best solve the flooding problem. The Idaho Department of Water Resources' operations bureau chief is the chairman of a state agency committee that is working with the Corps of Engineers.
- 5.2 Place 1984 flood-level vandal resistant markers in strategic and prominently visual parts of past flooded areas in the city and along the Salmon River in river flat areas on county road property. The city council and the county commissioners should review and decide by the end of July 1985 on whether to pursue this marker proposal. Also, the county commission and other local leaders should give further consideration to a proposal to record a floodplain notification on county records.
- 5.3 Evaluate potential state floodplain management act. The Idaho Department of Water Resources, which manages parts of the federal floodplain insurance program in Idaho, currently believes a potential act will largely be a duplication of present federal activities.
- 5.4 Federal and state agencies are to work closely with the city and county officials in future disaster activities and provide added outreach efforts for individual residents to contact government agencies. Discussions to initiate the following changes should take place in 1985 unless otherwise noted.
  - A. Each involved agency in a disaster follow-up is to take the leadership to schedule periodic meetings with a city and county representative to review with them a list of people helped, the general nature of the use of the money involved, as well as the general direction their agency program is going, and related problems. The more involved agencies are the Idaho Department of Health and Welfare, the Idaho Housing Agency, SBA and FmHA. The coordinator of the Idaho Bureau of Disaster Services should meet with the state agencies to encourage this policy. The Regional Director of FEMA should pursue this recommendation with his regional federal agency counterparts and with the national FEMA office.
  - B. Out-of-town agencies, such as SBA, should appoint a local, relatively knowledgeable person as an ombudsman to work with local people. The Associate Director of State and Local Programs and Support of FEMA should undertake discussions with the appropriate SEA manager in order to encourage this policy.
  - C. Future Individual Family Grant (IFG) applications and administration should be handled in a central disaster office if one is designated or in an office in the nearest city hall.
  - D. Some slight adjustment of the IFG criteria may be needed. A representative of the coordinator of the Idaho Bureau of Disaster Services should further discuss these criteria and the previous recommendation with the IFG program leaders.
  - E. Many affected agencies should increase their outreach efforts significantly over those used in their regular programs. In rural areas an increase in the outreach efforts done by the U.S. Department of Agriculture (USDA) will give added benefit. The Regional Director of FEMA should discuss this need with appropriate state directors of the USDA agencies at the time of the next disaster.
- 5.5 Provide mechanism for a very heavy and immediate local equipment response to levee (bank) overtopping. The operations and training officer for the Idaho Bureau of Disaster Services will need to work with the county civil defense directors during the current year of 1985 and subsequently.
  - A. The Idaho Bureau of Disaster Services is to give local civil defense directors continued training in working under the most adverse weather conditions with contractors and city/county maintenance personnel.
  - B. Preliminary meetings with contractors are to be undertaken by local civil defense directors to provide mutual knowledge of problems with rapid mobilization. These meetings should be repeated on two-year intervals.
  - C. A list of potential general superintendents available for selection by the county civil defense directors is to be kept current by the civil defense director and monitored by the Idaho Bureau of Disaster Services.
  - D. The Idaho Bureau of Disaster Services is to make sure local civil defense directors have immediate access to extensive lighting equipment for nighttime work.

# INTRODUCTION

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The ice-jam flooding from the Lemhi River in January 1984 was a type of event that reoccurs periodically along river areas in extended, very cold periods. This ice-jam flood at and near the central Idaho town of Salmon was typical in that it was accompanied by nighttime Fahrenheit temperatures averaging 20 degrees below zero and the warmest daytime temperature of near zero. Colder temperatures occurred upstream. Daylight was limited to about nine hours.

This report will give some background of the flood and discuss the flood damages and their causes. The report then will present recommendations that the team for this report feels should help reduce a reoccurrence of the level of losses sustained. This report is written for both the local people and for government leaders at the national and state levels. Some readers already will be aware of presented information; yet both local people and governmental leaders are considered.

Nationwide there was a significant increase in the level of federal disaster assistance as a result of the 1956 passage of Public Law 84-99, known as the "Watershed Protection and Flood Prevention Act" which authorized significant Corps of Engineers work. The Disaster Relief Act of 1974, Public Law 93-288, provides for a concentrated federal response with assistance to individuals. Millions of dollars have been spent from federal sources for disaster relief. Since 1980 the total expense generally is shared: 75 percent federal funds, 15 percent state funds and 10 percent local funds for specifics. (See the following section, Description of the Flood-Financial Impact.) These monies generally have been used for repair and restoration to predisaster condition. In many cases, this expenditure when flood related meant placing the facility right back in the path of another flood without any improvements to prevent future damage.

In spite of this expenditure, flood losses have continued to rise. In an effort to stem continuing increases in disaster relief programs and development pressure within the nation's floodplains, the federal, state, and local emphasis has shifted toward a comprehensive and coordinated approach to floodplain management. The current emphasis on remedial measures will help reduce the total outflow of money for this flood-related expense, thus allowing tax money and local people's own individual money to be used for other priority items. Each of the remedial measures is a difficult choice that involves change but is made with the objective of providing more remaining spendable money for individuals. These measures include 1) removing activities from hazard areas, 2) adding flood protection where this is the highest net benefit over cost alternative and 3) individual-structure floodproofing.

This report will address some of the remedial measures and presents the Hazard Mitigation Planning Team's recommendations.

## AUTHORITY

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Section 406 of Public Law 93-288 known as the Disaster Relief Act of 1974 and subsequent regulations (44 CFR 205.400 and the following, particularly sec. 205.405e) indicates that as a condition of any loan or grant, the state and local applicant shall evaluate hazards in the declared areas and take appropriate action to reduce such hazards. Related authority, partially as an outgrowth of the above act, is contained in the Idaho Disaster Preparedness Act of 1975, in the Governor's Executive Order of October 28, 1983 and in the FEMA-Idaho Disaster Assistance Agreement of February 24, 1984. A Hazard Mitigation Planning Team for the Salmon ice-jam flood was established to fulfill the above requirements. Team participants are listed in appendix A. This report resulted and is submitted to the appropriate local, state and federal governmental units.

## PURPOSE

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This report states the remedial measures implemented or to be implemented to reduce future disaster damages in Lemhi County.

1. The long-term goals of this hazard mitigation report are:

1. Protection of life and property through the avoidance of unnecessary loss.
  2. The enhancement of beneficial and economic uses of floodprone areas.
  3. Protection of natural systems with portions of this floodplain above the river banks that serve to move flood water downstream.
2. In order to meet four federal requirements, this report is intended to be:
1. A final report submitted by the State Hazard mitigation Coordinator (Ralph Mellin) to the Federal Emergency Agency (FEMA) Regional Director (William H. Mayer) as required by 44 Code of Federal Regulations (CFR) 205.403c.
  2. A hazard mitigation plan(s) submitted by the State to the FEMA Regional Director as referred to by 44 CFR 205.403e.
  3. A joint report by the FEMA Hazard Mitigation Coordinator (Robert Freitag) and State Hazard mitigation Coordinator to the FEMA Regional Director and to the Governor's Authorized Representative (Darrell Waller) as required by 44 CFR 205.411b.
  4. A final report by the FEMA/State planning team to the FEMA Regional Director through the Governor's Authorized Representative as required by 44 CFR 205.411c.

In summary, this report is intended to be the report of both the FEMA/State survey team and the FEMA/State planning team since individuals on each team served in dual capacities.

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## SCOPE

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This report will address the damage noted in the 15-day Interagency Hazard Mitigation Report. Causes of damages will be noted along with short-term and long-term mitigation measures.

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## BACKGROUND

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President Reagan declared the Lemhi County ice jam, ice and flooding damages a disaster on February 16, 1984. The entire county was included in the declaration. On the basis of the request from the state of Idaho, the declaration was established January 17, 1984, as the beginning date for damages eligible for federal assistance. The disaster declaration provided assistance from the Federal Emergency Management Agency for individual assistance. Subsequently on March 23, 1984, assistance for public works was approved.

### *1. Description of the Area*

#### **County**

Lemhi County is located in east central Idaho, with Montana bordering on the east; see figure 1. Large areas of mountainous terrain, much of it administered as wilderness and roadless areas cover the county. Ninety-one percent of the county is federally owned. Significant associated outdoor related, economic activities related to the roadless areas as well as some mining and lumbering take place in the county. Two large, high elevation, livestock economy, river valleys, the Lemhi and Pahsimeroi, are in the southeast panhandle of the county. The main river system is the Salmon which enters the county with an estimated average annual flow of over one million acre feet and leaves the county with the estimated average annual flow of over four million acre feet while the estimated average annual flow at Salmon above the Lemhi River is one and one-half million acre feet. The Lemhi River's estimated average annual flow is 200,000 acre feet at Salmon. The Lemhi River drops 40 feet in its last 1.5 miles at the mouth within the city limits of Salmon. The gross area of the county is 4,587 square miles or 2,936,000 acres, which is about the size of the state of Connecticut. The 1980 population was 7,460. The governing body is a three member county commission; Louie Demick is the current chairman.

The average temperature of the valley areas is about 45 degrees Fahrenheit but with considerable variability ranging from 30 degrees below zero to over 100 degrees. The growing season averages 100 days. Average annual precipitation in the

valley areas is 10 inches, with the majority occurring in the spring and fall. Precipitation in the mountain area ranges up to 50 inches per year.

Since ninety-one percent of the county is the federally owned mountainous areas, the developable private land is mostly on the valley floor. Relative to many other areas of the state, a larger part of the private land is in the floodplain. When the floodplain mapped area from the U.S. Geological Survey Flood-Prone maps and the Corps of Engineers Special Flood Hazard Information Map is superimposed on the Salmon Surface Management Status Map (land-ownership) available from the U.S. Bureau of Land Management, the net non-floodplain land available for development is seen. The private land area does not appear to have a high percentage of river impacted flood-prone land; however, additional flood hazards are found beside the many side drainages. These side drainage flood-prone areas need to be considered for they also subtract flood-prone land from the total available private land available for building.

## **City**

The county seat and largest community in the County is Salmon, which is located in the east-central part of the county at the confluence of the Lemhi River and the Salmon River (see figure 2 for the layout of the city in relation to the rivers). The elevation level is 4,000 feet. Salmon's 1980 population was 3,308. The major trade centers are Missoula, Montana, located 141 miles north (population 33,388), and Idaho Falls, Idaho, located 161 miles southeast (population 39,734).

The governmental structure of Salmon is a mayor-council type. The mayor and six council members are elected to 4-year terms. A full-time appointed administrator, currently Polly Prchal, handles the day-to-day functions; however, a consultant provides engineering services. The planning and zoning commission is appointed by the mayor and the city council. The building inspector serves both the city and the county. The public works department also serves both the city and the county. The public works department consists of eight full-time employees headed by a superintendent. Sewer service and water are provided by the city of Salmon for residents within the city limits. No sewer service is provided outside the city limits. If sewer service is provided to unincorporated areas in the future, the area must either be annexed into the city or be incorporated into a new separate sewer district.

The city is participating in the emergency phase of the National Flood Insurance program with an ordinance limiting floodplain development. The draft FEMA Flood Insurance Study and draft Flood Boundary and Floodway Map (hereafter called Floodway Map) were delivered to the city in the fall of 1984. After the current ice-jam flood, the city placed a 90-day moratorium on further development within the flood boundary identified on the Floodway Map.

The city council lifted the moratorium on April 16 provided any building conform to the more stringent draft floodplain ordinance and the more inclusive draft Floodway Map (both adopted in August 1984). The more stringent ordinance refers to a high hazard area recently identified by the Corps of Engineers, in which there is an above average probability of flooding every five years. Building requirements are much more restrictive in this area.

The city council also has recently passed an impact area ordinance in which their zoning commission reviews building plans within one mile of the city limits. This area of impact virtually will cover the area flooded by the recent ice-jam flood and the above noted high hazard area even though many of these areas are outside the city limits.

The interim 1976 Flood Hazard Boundary map for the city of Salmon did not identify as areas of special flood hazard, much of the area flooded within the city. Therefore, significant new construction was built in the proximity of the Lemhi River and received damage. The largest damage was to the Imperial Apartment Complex, which is located on the west side of Imperial Way. These apartments house several low-income families. Also flooded was the Salmon Meadow Campground trailer court constructed after the 1976 mapping. Both the apartment complex and the trailer court were located over two blocks laterally from the Lemhi River, and not within the special flood hazard area identified in 1976. These areas, however, are shown now as within the floodplain on the 1983 Floodway Map.

## ***2. Description of the Flood***

### **Physical Impact**

This 1984 flooding from the Lemhi River was interpreted by the Corps of Engineers, Walla Walla District to be a 100 year event; that is an event which has a one percent chance of occurring to its extent. This mid-winter major flood was



caused by ice jamming in the Lemhi River just above its junction with the Salmon River. The first Lemhi River flood damage occurred on January 19, 1984; additional flooding occurred on January 21, 23 and 28. The ice jam went out of the Lemhi River later in the day of January 28 although some areas of the Lemhi River opened up on January 20. Ice up to 3 feet thick remained in many homes while ice nearly 5 feet thick remained around the homes and along streets. (See figure 3 for the extent of the urban area flooded. Figure 4 is an aerial photo of the 1982 development in the Lemhi River area of the city of Salmon.)

Although the largest flood damage started on January 19 from the Lemhi River, initial damage started with an ice-jam build-up in the Salmon River on December 22. This ice-jam broke on December 27, but built up again on December 29 and broke again on December 31. During these ice-jam build-up times, there was water movement over the Salmon River banks but corrective levee repairs were satisfactorily made by the local, city and county crews. Likewise, local crews worked to control the Lemhi River in mid-January with some success but on January 19 the build-up of ice was more than local crews were able to match. Most of the property damage from the ice-jam flood was in the town of Salmon, there also was overbank movement of water onto developed agriculture land in the rural area. Along the Salmon River, as identified by the Corps of Engineers, Walla Walla office, an area of 3,000 acres was inundated in and below Salmon of which 200 acres were within the city limits of Salmon. An estimated 1,000 acres of agricultural land immediately upstream from Salmon were damaged in addition by Salmon River ice and water. Most land outside the city limits of Salmon currently is used as permanent pasture and consists of both native and improved grasses.

At the time of the Lemhi River flood, ice generally was in the main Salmon River from the river constriction at Dump Creek to above Salmon. (See figure 5 for location.) On January 20 an inspection of the Salmon River was made by helicopter. Observer Steve McCormick of the Idaho Department of Water Resources reported a few small places of open water existed at that time. Figure 6, a photograph taken about January 20 and published in the local paper on January 26, shows some open water on the Salmon River at the mouth of the Lemhi River. This photograph was taken from a point about one mile (6,500 feet) below the ice jam that caused the Lemhi River to leave its banks. Vertical ice banks on the river's edge are noted in the photograph; these ice banks indicate a prior river freeze-up. The point raised is that the length of time may be very short in which an ice jam remains in a particular location. Yet, this short time can cause extensive damage unless substantial efforts are immediately made to control the water flow.

The Lemhi River falls 47 feet in its last one mile plus (6,500 feet) past the point of flooding which was just below the Lemhi Street bridge. The five-foot plus water level rise at the river mouth because of ice in the Salmon River (seen in the photograph) caused a slowing of the Lemhi River flow at the river mouth and ice formation in a progressive pattern moving upstream. This water level rise possibly contributed to the flooding one mile plus upstream and 47 feet higher in elevation. The other causes of the flooding are (1) the extreme cold which caused, at the point of flooding, a very large ice buildup and (2) the somewhat low Lemhi River banks and levees at the point of flooding.

At the times of the above noted flooding, minimum daily Fahrenheit temperatures at Salmon generally ranged from minus 15 to minus 29 degrees. The upstream temperatures were colder, although at times atmospheric inversions in the mountain valleys, such as at Salmon, trapped in the cold air. During these times, some upstream temperatures were not colder but near the temperature at Salmon; at other times most upstream station temperatures were 10 to 15 degrees cooler. Upstream, the record at a high mountain valley station during these cold periods was minus 54 degrees on the date of the minus 29 degrees at Salmon. A quick and substantial establishment of frazil ice (suspended, clinging ice) flowing under an ice cover forms in these conditions. Ice-jam flooding from the damming effects of this clinging ice resulted above constricted, slower moving areas of the rivers. Each cold day brings a longer ice jam above the river constriction and a somewhat higher flooding level.

See appendix B for an extended review of the factors relating to ice-jam formation with a particular emphasis upon the Salmon area. The appendix material was prepared by the U.S. Corps of Engineers, Walla Walla, Washington District with assistance from their Cold Regions Research and Engineering Laboratory at Hanover, New Hampshire. Also, the local newspaper published as a special edition an extensive review with many photographs of the flood impacts. A copy is attached as appendix C.

## **Social Impact**

No significant injuries were sustained. A few minor injuries did occur during evacuation. The professional search and rescue operations, which took place on several occasions, most assuredly prevented serious injuries. High water and/or ice displaced Three hundred twenty-five people. Local search and rescue club members and other volunteers expended 6,153 hours in rescue operations. The city of Salmon and Lemhi County employees also expended 3,362 hours of labor associated with the evacuations. Food kitchens were established for six days during the peak period. During the ice jam, flood evacuees

stayed with friends and relatives. A financial and psychological strain thus was placed not only on the evacuees but also on those who received the displaced persons.

Eighty-one residences, including mobile homes and a 66-unit apartment complex in the area received varying degrees of damage which required the evacuation of most flooded families from the dwellings. There were 108 registrations at the Disaster Assistance Center. Seventy applications were for temporary housing with 33 being eligible, 21 ineligible, and 16 withdrawals. The 33 eligible applicants included 12 rental housing applicants, 10 mini-repair program homeowner applicants, and 11 transient program applicants. There were no eligible applicants for emergency conservation measures, disaster unemployment assistance or emergency food stamps. Five eligible claims for Flood Insurance assistance were processed. Twenty-seven applicants received Individual Family Grants.

Five Small Business Administration (BHA) loans for business were approved. The BHA also approved 30 loans for housing. The flood water and ice affected: two oil companies, a beer distributor, a river tour business, a horseshoeing business, a sawmill as well as the mobile home court and apartment complex mentioned previously. Water and ice damaged inventories and equipment of most of the above businesses while the intense cold caused an extensive cleanup of ice effort. The apartment complex suffered some structural damage, and all units required major repairs.

Damage to the city of Salmon property included the roadbed and the surface of North St. Charles Street, Confederate Drive, North Daisy Street, and Imperial Drive. In addition, the city recreation area, sewer lagoons and sewer pumping system suffered considerable damage. Damage to Lemhi County property included extensive road surface and roadbed damage to rural North St. Charles Street and the levee along the Lemhi River. Local preventative measures were limited to attempting to contain floodwater in one area and channeling it back into the river.

## **Financial Impact**

### *Public*

#### **Financial expenditures were:**

##### Lemhi County

Flood fight (This includes search and rescue expenditures; however, most search and rescue efforts were volunteer)	\$14,745
Repair to damage of county road	<u>31,235</u>
Subtotal	\$45,980

##### City of Salmon

Flood fight	17,719
Ice cleanup	2,075
Repair to city streets, sewer system, parks	<u>123,356</u>
Subtotal	173,150

##### Corps of Engineers

Levee reconstruction	<u>\$213,827</u>
Total Public Assistance	\$432,957

The Lemhi County and city of Salmon expenditures as were shared by funding 75 percent from the U.S. Federal Emergency Management Agency, 15 percent from the state of Idaho through the Bureau of Disaster Services and 10 percent by the county or the city. The Corps of Engineers' expenditures were federal funds provided for emergency use.

### *Private*

#### Individual assistance expenditures were:

SBA Business Loans	\$63,800
SBA Home Loans	480,000

Flood Insurance Claims	4,379
Individual Family Grants	45,174
Temporary Housing Grants	<u>18,891</u>
Total Private Assistance	\$613,044

Individual Family Grant funds are shared: 75 percent federal funds and 25 percent state funds. Temporary housing grants are 100 percent federal funds.

Total Public and Private Assistance: \$1,046,001

In addition, administrative expenses were provided for the above loans and grants. Also, planning and administrative expenses were provided by these loan and grant giving agencies and by other natural resource agencies named below. The amount of these administrative expenses is difficult to determine; however, it is estimated at 15 percent of the above total public and private assistance or  $\$1,046,001 \times 0.15 = \$156,900$ .

Miscellaneous loss amounts and the time given by individuals also are difficult to determine. Mention was made of the volunteer rescue efforts, which was extensive and very thoroughly carried out. In addition, there was cleanup labor by residents and business owners. Since funds generally were not expended, a price is not placed on this work, although some of the time was taken from regular work activities, so an actual time loss occurred. Some smaller personal losses for which individuals did not seek loans or grants also occurred. In lieu of using a zero value an estimate of 15 percent of total private assistance is used,  $\$613,044 \times 0.15 = \$91,957$ . Some of the above noted employment time loss could be in this \$91,957. The total ice-jam flood costs therefore are estimated to have been \$1 300 000 (that is  $\$1,046,001 + \$156,900 + \$91,957$ ).

## **GOVERNMENTAL RESPONSIBILITY**

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### **A. Federal agencies involved and duties are:**

#### **1. *Federal Emergency Management Agency (FEMA)***

1. Provide federal leadership.
2. Provide state and local technical assistance and counsel.
3. Identify hazards and make recommendations for the damage survey reports.
4. Provide model regulations and suggested standards for the FEMA/State planning team and FEMA/State survey team.
5. Work with the State to update existing statewide plans.
6. Process flood insurance claims and encourage new policy applications.
7. Recommend and follow up to insure implementation of necessary action of all involved federal agencies.

#### **2. *Corps of Engineers –***

Work with local people and state agencies to develop and implement a cost effective and longer-term solution to the flooding problem. Also, the Corps of Engineers (COE) provides for major emergency assistance to protect life and property (Public Law 84-99). A most outstanding effort was done at Salmon as seems to be usual under the COE emergency programs. Mr. Thomas Tate assigned from the Walla Walla COE office led this emergency program effort. A quick, thorough, and cost effective repair of levees on the Lemhi and Salmon rivers appears to have been the result.

#### **3. *Forest Service –***

Provide for erosion control measures on Forest Service land to prevent additional major catastrophic movement of material into the Salmon River. The Forest Service staff is studying measures to improve their sediment control project to further reduce sediment movement down Dump Creek from Forest Service land into the Salmon River. Past sediment movement down Dump Creek over a period of many decades has accentuated the constriction in the Salmon River which is a major point of the start of -ice jams that eventually reach upstream to the city of Salmon.

#### **4. *Small Business Administration –***

Provide funds to repair and rebuild residential and business flood losses. In the Lemhi County area ice-jam flood, the SBA set up a temporary office in Salmon, which was subordinate to the SBA San Francisco regional office. Only regular programs, not emergency programs, are administered from the SBA state office in Boise. As is seen from the amount of SBA loans made, the Small Business Administration provides a means to assist in the recovery of a significant part of the flood losses.

#### **5. *Farmers Home Administration –***

Provide funds to implement longer-term residential and farm flood damage prevention measures for protection against future floods.

#### **6. *Soil Conservation Service –***

Can provide technical assistance to rural landowners that want to reduce future damages.

#### **7. *Fish and wildlife Service –***

Provide planning assistance and review of flood control measures in order to reduce adverse affects on fish and wildlife.

### **B. State agencies and special personnel involved were:**

#### **1. *Governor's Authorized Representative***

Is the Coordinator of the Idaho Bureau of Disaster Services and is responsible for the performance of hazard mitigation activities under the State/Federal Agreement.

#### **2. *State Hazard Mitigation Coordinator***

Is assigned from the Department of Water Resources; the duties are to:

- a) Maintain frequent contact with disaster assistance applicants, that is, the local coordinators and officials.
- b) Arrange State funding and technical assistance.
- c) Analyze preliminary damage assessments and damage surveys.
- d) Visit sites of significant damage and evaluate hazards.
- e) Investigate selected individual damaged facilities.
- f) Review applicable land-use regulations, construction standards and codes.
- g) Schedule follow-up meetings with applicants.
- h) Evaluate FEMA provided model regulation, suggested standards and pertinent references.
- i) Identify significant hazards and provide recommended mitigation measures for each.
- j) Implement timely/adequate local/state mitigation actions.
- k) Make specific recommendations concerning comprehensive planning and develop the Hazard Mitigation Report using local input.
- l) Identify applicant's options for decision making.

#### **3. *Other Department of Water Resources' duties***

To coordinate State agencies in the review and implementation of a long-term flood relief solution.

#### **4. *Bureau of Disaster Services provides the State Planner, whose duties are to:***

- a) Oversee compliance with Federal-State Agreement.
- b) Review/evaluate state and local emergency and hazard mitigation plans.
- c) Verify the impact of the major disaster (hazard analysis).
- d) Develop short-term planning objectives.
- e) Prepare recommended target dates and schedules for accomplishment of each mitigation measure.
- f) Advise on follow-up meetings with applicants.
- g) Assist in the development of the hazard mitigation report.
- h) Develop planning team report of activities, findings and recommendations of further planning requirements.

## **5. *Department of Health and Welfare***

Administers the Individual Family Grant program with representatives at the local level.

## **6. *Department of Fish and Game***

Provides planning assistance and review of flood control measures in order to reduce adverse affects on fish and wildlife.

### **C. City of Salmon and Lemhi County**

- a) Work with FEMA-State team, which will assess damage and develop a hazard mitigation plan and related plans if needed.
- b) Arrange local participation.
- c) Inform local officials and citizens of activities.
- d) Collect and transmit local comments.
- e) Implement appropriate and acceptable mitigation actions.
- f) Provide evidence of compliance when required.

## **EXISTING PROTECTIVE MEASURES**

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Within Salmon, along the right bank of the Salmon River, as one faces downstream, are located levees. Along the left bank of the Lemhi River there is a small levee within the town that gives some spring flood protection. (The Lemhi River right bank area largely is undeveloped and is outside the city limits.) Excessive spring runoff generally is controlled with the current levee system beside the Salmon and Lemhi rivers. During the current flood, the Corps of Engineers, as part of its flood control efforts repaired and restored the Lemhi River levee to its original condition. No riprap levee protection is placed along either levee. The Corps of Engineers recommends riprap protection be built for a permanent levee system.

Floodplain zoning, as part of the conditions for flood support for real estate financing, has been in effect within Salmon and to a significant extent in Lemhi County, however, there have been less than adequate maps available for the county areas. Work now is underway to provide more detailed flood plain maps. (See recommendation element no. 3.1.) Within the city, this flood also made it evident the earlier Flood Hazard Boundary map was not correct. The recently completed Flood Boundary and Floodway Map has corrected the previous errors.

## **HAZARD MITIGATION TEAM RECOMMENDATIONS**

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The Federal Emergency Management Agency team representative developed the initial strategy outline through meetings with local officials in February 1984. A first meeting with local officials on this report and ideas on recommendations was held on April 4, 1984. Later the Idaho Department of Water Resources' team representative drafted this report. The tentative written recommendations were reviewed subsequently at Salmon on September 15, 1984 with the principal team members. The county and city area team members gave significant input at that meeting. These final recommendations attempt to reflect that input. The recommendations are listed below as elements with a discussion of each item and are categorized into strategies.

### **Strategy #1 - Encourage Individual Mitigation Efforts**

Due to the extensive investment in much of the floodplain land, the reasonable protection offered by the repaired levees and the possibility of further reduction in ice-jam frequency with the Corps of Engineers' involvement, the team adopted a strategy of encouraging individual mitigation efforts for this flood. The risks did not warrant abandoning these flooded neighborhoods. The strategy applied to all the city and county flood-prone land not included in the high hazard area. (See strategy no. 2)

The apparent structural integrity of the existing development also supported this strategy no. 1. Many of the older homes were log structures with no insulation and were heated with almost indestructible wood stoves or easily repaired

electric baseboard heaters. The most severely damaged apartment units were repaired for much less than expected. The units were equipped with radiant ceiling type heating, which was not damaged. Carpets were cleaned, wallboard and insulation were replaced, and the unit interiors were repainted--all for under \$4,000 per unit. Also, many occupants were able to move their contents to the second floor. In addition, a significant number of residents place high value on their floodplain location and feel additional investment of their own is warranted.

#### Element 1.1

The city is encouraged to come into compliance with the National Flood Insurance Program immediately. (This has been accomplished as described below.) In response, on February 21, 1984 the city adopted a moratorium prohibiting new development and substantial improvement throughout the city. The moratorium partially was lifted April 16 with the provision that construction would be done in such a manner that it would meet the requirements of the draft floodplain ordinance. A floodplain ordinance must have been and was enacted by December 4, 1984, as noted in the following plan element. Commercial mobile home insurance, if is noted, generally includes flood insurance while most attached homes must get additional insurance provided through the National Flood Insurance program or through the Homeowners Catastrophic Insurance Trust administered by Trust Co., Inc. of Salt Lake city. All of the above insurance is sold through many local, independent insurance agents.

#### Element 1.2

Encourage city to adopt a flood damage reduction ordinance. Only minimum floodplain regulations were adopted by resolution in October, 1975. As part of the process of adopting a flood damage reduction ordinance the Flood Insurance Study and the accompanying preliminary Flood Boundary and Floodway Map and the preliminary Flood Insurance Rate Map have been completed and were delivered to the mayor by letter on January 23, 1984. Final elevations on the new maps were established with notice to the city by letter of June 4, 1984. To remain in the National Flood Insurance program and to allow for continued availability of commercial loan funds for real estate transactions, the city was to adopt standard floodplain regulations by December 4, 1984. Early in 1984 the city council received a model floodplain ordinance from the Federal Emergency Management Agency (FEMA). The city council completed the review of the ordinance and related material with only minor changes being made to reflect the local situation. The necessary ordinance with the standard floodplain regulations was adopted on August 6, 1984.

In the administration of the ordinance, the city building inspector certifies the lowest floor elevation of new buildings within the floodplain. This certified elevation is used to determine the rate the building owners will pay for flood insurance. The building inspector uses the Flood Insurance Rate Map, which shows the floodplain areas base-flood elevation lines along the Salmon and Lemhi rivers. These elevations are not shown in the marked floodplains of tributary streams within the city. In the past, the base flood elevation used by the city for these tributary streams, because of a lack of other information, is one foot above the high water level mark of the stream. The new (August 1984) ordinance provides that at a minimum for new structures in the floodplain, the first floor shall be two feet above the highest adjacent grade. Also, the base flood elevation will be the average ground level at the flood boundary line along the tributary stream (see the Flood Boundary and Floodway Map or the Flood Insurance Rate Map). (The city could require the new builders to bring by engineers level to the building site this base flood elevation. Measurement would be from a point along the watercourse at the flood boundary line. That point would be on an imaginary line to the proposed building). By city ordinance, **the first floor of new buildings must be not lower than the flood elevation.**

In regard to the Flood Boundary and Floodway Map and the Flood Insurance Rate Map recently provided, the maps should have indicated a reference mark with an established elevation along the Salmon River in the center of the city and on the southwest side of the city. The city informally has asked a FEMA representative to provide a couple more elevation marks. FEMA's representative indicated they might be able to provide these elevations. In spite of the map preparation weakness, the Corps of Engineers may have established elevations in these areas that may be able to be used.

#### Element 1.3

Encourage owners of substantially damaged structures to take advantage of minimization alternatives offered through the Small Business Administration loan program and the Individual Family Grant program.

The smaller cost items should be done by some individual homeowners soon. Some additional flooding is quite

possible in the lower areas before more permanent protection can be developed by a Corps of Engineers project.

In regard to flood-damage reduction measures, homeowners were made aware of the U.S. Small Business Administration (SBA) loan program, and the FEMA's Individual Family Grant (IFG) program administered by the Idaho Department of Health and Welfare through representatives temporarily located in Salmon after the flood. The application period for the SBA program and the IFG program lasted two months and three months, respectively, from February 16, 1984, the date of the presidential declaration. The interest rate for the SBA residential loan program was 12 3/4 percent except for applicants who were unable to obtain credit elsewhere, their rate was 6 3/8 percent. The residential maximum loan was \$55,000. (After April 18, 1984, a \$100,000 residential maximum and \$20,000 personal property maximum applies.) In Salmon twenty-five residential loans for a total of \$231,000 were approved. There were 27 individual family grants made by the Idaho Department of Health and Welfare for a total of \$45,700.

The maximum business loan is \$500,000. In Salmon five business loans for a total of \$63,800 were approved. For businesses the interest rate was 11 percent, except for applicants who could not obtain credit elsewhere; their rate was 8 percent. On April 18, 1984 the interest rate was lowered by public law for outstanding balances as of that date to 8 percent if credit was available elsewhere and to 4 percent for applicants who could not obtain credit elsewhere.

SBA floodproofing improvement loans cannot be made to protect property from future flooding unless they are required by a local agency. FEMA, the Corps of Engineers, and floodplain management agencies recognize many floodproofing measures as cost effective as opposed to continual repair of flood damages. Since FEMA provides in the regulations for its own programs that floodproofing is an acceptable expense when it is recommended by the Hazard Mitigation Planning Team, SBA should be encouraged by FEMA's Washington office to allow for these same floodproofing uses of its loan funds when recommended by the Hazard Mitigation Planning Team. As mentioned, SBA will allow floodproofing loans if floodproofing is required by local/state enactment. Some states and many localities are hesitant to make some personal expenditures a requirement even when they may be for individual benefit. Therefore, it is recommended the SBA national office change its regulations also allow flood-proofing expenditures for its loan funds when Hazard Mitigation Planning Team recommends such actions. The Regional Director and the Assistant Director of State and Local Programs and Support of the national office of FEMA should pursue this recommendation this year 1985.

It is noted Farm Home Administration (FmHA) allows for funds from its Home Ownership program to be used for rehabilitation and improvements for moderate income people. These improvements could be for floodproofing against future disasters. A Flood Hazard Mitigation Planning Team recommendation is not needed. The 1984 maximum eligible income level is \$22,000 for a family in Lemhi County. Some income may not be counted, so applicants near this income level should check with the local FMHA office. The 1984 interest rate is 11 7/8 percent; however, if a family is judged as not able to afford this rate, a lesser rate down to as low as one percent is available. Some grant funds may be available for certain hardship cases. For some higher income levels within the above FmHA eligible categories, there will be, after application has been made, a waiting period for funds to be become available. It is recommended that residential owners located within a floodplain make use of this available FmHA program for long-term "economic" floodproofing improvements. It is further recommended that the FmHA manager write in the near future a short article for the local newspaper and prepare a radio spot for local use so the availability of this program is brought to the attention of the local people.

For residential owners, including rental property owners, the use of commercial loan funds is encouraged to provide the needed funds for long-term economic floodproofing improvements. As reported locally by the Internal Revenue Service following the flood, rental and business property owners can depreciate their improvement expenditures over 18 years; repair expenses can be deducted in the current year. All owners also can deduct interest expense and all owners will be eligible for lower flood insurance rates for each foot the first floor level is raised, generally to a point one foot above the base flood elevation. A basement is defined as the first floor. (Slight additional insurance reductions are available for no basement two-story houses raised an added foot and for no basement one-story houses raised an added one and two feet.) It is recommended owners able to qualify for commercial loans construct "economic" floodproofing measures.

For low and moderate income individuals and families that are not able to meet loan criteria from SBA, the IFG program administered by the Idaho Department of Health and Welfare will provide up to \$5,000 for disaster-related necessary expenses or serious needs. Seventy-five percent of these funds are provided by FEMA with the remainder from state appropriations.

Floodproofing improvements are an eligible expense under FEMA guidelines. The actual rules and regulations developed by the Idaho Department of Health and Welfare, however, do not provide that floodproofing work is an eligible expense. Yet the families which participate in the IFG program many times are a majority of the established homeowners located in a flood-prone area. These lower income families need some help in safeguarding their structures. They generally

cannot afford to relocate. With these considerations and the very cost effectiveness of minimum floodproofing in mind, it is recommended that the Idaho Department of Health and Welfare change to provide floodproofing as eligible IFG expense if the Hazard Mitigation Planning Team recommends it. The Idaho Bureau of Disaster Services should provide continued encouragement for the provision of floodproofing as an eligible expense in the individual and Family Grant program. A goal of accomplishing this change in regulations by June 1985 is proposed.

Floodproofing generally consists of some "economic" elevation of the foundation either directly, with piles (poles), or with fill material, or by providing a landscaped earth berm or a masonry wall around the home. Raising basement window wells, dryer vents and other openings, or the providing for temporary barriers on the outside of the lower part of entrances and commercial display windows of masonry building are generally economic. (For floods of over 2-3 feet on the wall it may be better to allow water to enter the building to prevent wall collapse. Water cannot easily be prevented from entering through the walls of wood frame buildings.) Other floodproofing measures consist of adding automatic or manual valves to prevent sewer backup, and raising critical utilities such as a heating plant and electrical equipment to an upper floor; also, strengthening basement walls and anchoring frame homes to their foundations many times are economic floodproofing measures.

Real estate owners will find the following references may be of use for planning floodproofing work. A limited number of all but number six are available at no cost. The Salmon Public Library and other interested parties should acquire these references by the last of June 1985 if possible. The operations and training officer for the Idaho Bureau of Disaster Services also may want to consider making some of these references available to county civil defense directors for their use and distribution.

Center for Urban Studies, The University of Chicago, Introduction to Flood Proofing (Chicago: 1967), this very good manual with several ideas for commercial buildings is out-of-print but can be copied by the Idaho Dept. of Water Resources - Telephone 334-4496.

Colorado Water Conservation Board, Colorado Floodproofing Manual (Denver: 1983), this good extensive manual can be order from the Colorado Water Conservation Board Telephone 303-866-3441.

Illinois Division of water Resources, Protect Your Home From Flood Damage (Chicago:1982), this good manual can be ordered from the Illinois Division of Water Resources -Telephone 312-884-4883

U.S. Federal Emergency Management Agency, Design Guidelines for Flood Damage Reduction (Washington, D.C.: 1981), Chapters 3, 4 and 5 - gives general guidelines order from Federal Emergency Management Agency Telephone 202-287-0769.

U. B. Federal Emergency Management Agency, Elevated Residential Structures (Washington, D.C.: 1984), order from Federal Emergency Management Agency - Telephone 202-287-0769.

Venture Associates, Flood Emergency Handbook (1984), Chapter 5 - Planning Against Future -Floods. Other chapters provide good information on how to protect property during a flood and how to clean up after a flood. A good guide for the homeowner, which can be purchased for \$6.95 from the publisher at P.O. Box 1513, Paterson, NJ 07504.

#### Element 1. 4

Use Idaho Community Development Block Grant (ICDBG) funds as grants and loans for individual property improvements to minimize future flood losses.

The current state of Idaho selection criteria generally only allow for economic development type projects. In addition, competition is great for project funds with only about one-third of the submitted projects being funded each year.

A very good conceptual plan that will fit the economic and moderate-income criteria and that will make use of this program for reducing future flood losses may be difficult to develop. A similar program, the Idaho Water Resource Board's Water Management Account, currently is not authorized to make expenditures for flood control related activities. Amendment of that legislation could be considered. other state-administered funding programs are unknown.

#### Element 1.5



Provide natural ground elevation data on maps made available to the public by FEMA through the Federal Insurance Administration. This proposed FEMA, new policy has received significant discussion within the FEMA and floodplain management community. Ground-elevation data generally are available on the working maps prepared by the consulting engineers. The local government jurisdictions receive copies of this work; however, it generally is not available to the public without a lot of effort expended. Damage survey teams also would significantly benefit from the ready availability of ground elevation data. The teams could make better economic floodproofing and related hazard-mitigation recommendations.

The general dissemination and availability of this ground level elevation data in combination with base flood-level data should encourage more responsible decisions by building owners such as the advisability of raising foundations for existing facilities. This already existing data can be provided on FEMA insurance maps at relative low cost with an accompanying large potential for higher benefits and is recommended. The Regional Director and the Assistant Director of State Local programs and Support should pursue this recommendation during 1985 in the national office of FEMA.

## Strategy #2 - Establish a High Hazard Area

The Salmon River and Lemhi River provide a very high risk of flooding at their confluence. On the city side (west side) of the river, five mobile homes were substantially flooded, if not totally destroyed. Development of the land for these mobile homes was done by reclaiming the once marshy alluvial fan of the Lemhi River. The area has flooded three times in the past 12 months. The site has annual sewer problems and is poorly drained. Recreational vehicle parking is the other existing use in the area. The team found a recreational vehicle park an acceptable use for the area. The county side (east side) of the confluence of the Lemhi and Salmon rivers is largely undeveloped agricultural land, but parts have been platted as the North St. Charles Subdivision. Three homes now occupy the subdivision.

### Elements 2.1, 2.2, and 2.3

Develop a High Hazard Area designation and integrate it into city ordinances. A high hazard area has been delineated for the low land at the mouth and on both sides of the Lemhi River. (See figure 7 for location.) The high hazard area designation, with a very slight reduction in area, has been integrated into the city's draft floodplain ordinance noted in element 1.2. Within this area, no new permanent homes will be allowed. Uses allowed will be those such as recreational uses, which will sustain relatively less damage by flooding.

Although the county has not integrated the high hazard area designation into its ordinance, the city, through its review authority of potential development within one mile of the city limits, has significant input into the type of development that may take place in the delineated area. Therefore, the high hazard area delineated at the mouth of the Lemhi River is expected to have only limited classes of uses approved within it for new building permits issued by the county. The county commission is encouraged to still include this "high hazard area" category in its updated floodplain ordinance (see element 3.2.), which could be reviewed and acted upon by the end of July 1985.

### Element 2.4

A high hazard area delineation should be incorporated into new mapping by FEMA within urban areas, starting in Idaho. This will be a new FEMA policy. An approach that works well in Salmon has beneficial application in many other cities. A high hazard area designation would provide a focus point for the local governmental body in its effort to reduce future frequent flood losses. For example, this high hazard area could be a floodplain area where state and local acquisition efforts are directed. The Regional Director and the Associated Director of State and Local Programs and Support in the national office of FEMA are encouraged to pursue this recommendation with the Federal Insurance Administrator this year.

## Strategy #3 - Increase Regulatory Posture of County

The county is participating in the National Flood Insurance Program without a map. The county has no ordinance controlling flood-prone development, although the county is in the process of adopting a comprehensive code and "impact" zone strategy. Yet some problems associated with floodplain development have largely been ignored.

### Element 3.1

Map county flood-prone areas using existing data. Reconnaissance mapping of flood-prone areas in river bottom

portions of the county has been completed. The map scales are at 1:24,000 (1 inch = 0.4 mile, which is 1 inch = 2,000 feet) and 1:62,500 (1 inch = 1 mile) scale. The maps are available from the U.S. Geological Survey's office in Boise (telephone 334-1750). The 1:62,500 scale is too small a scale except for a general estimate of the flood-prone area location, yet it can still be used for this purpose. Most of the maps are at the better 1:24,000 scale. For the main Salmon River from Henry Creek to Carmen and at the mouth of the Lemhi River, use the maps in existing Corps of Engineers reports, "Special Flood Hazard Information Salmon River Ice Jams," 1984 and "Flood Plain Information, Salmon River," 1975 (map scale is 1 inch = 1,000 feet). In October 1984 more detailed maps became available as discussed below

In order to improve on the current mapping available, FEMA initiated contracts to provide more accurate mapping of the major river areas of the county. The map scale generally is 1 inch = 2,000 feet. The maps known as the Flood Boundary and Floodway maps and the Flood Insurance Rate Maps became available in a draft form in October 1984, as an attachment to a draft Flood Insurance Study for Lemhi County. One copy was sent to the county commissioners.

The Flood Boundary and Floodway Maps were done only for a limited area around Salmon. The Flood Insurance Rate Maps were done for these areas around Salmon plus for the remaining major river bottom areas of the county. The Flood Insurance Rates Maps give a flood insurance rating for the mapped area plus they give most of the information that is or would have been on the Flood Hazard Boundary and Floodway Maps.

These draft Flood Insurance Maps appear to do a good job of defining the floodplain of the major rivers in the county. These draft Flood Insurance Rate Maps therefore should be used now to guide development within the floodplains of the county. (Interim modification could be made by the county.) Extra copies of the draft Flood Insurance Study or the maps may be ordered by telephoning 1-800-638-6620. The use of these maps will reduce later state, federal and matching county money spent to repair newly constructed homes, businesses and accompanying community facilities.

The final version of these maps will be available by February 1986; one copy will be sent to the county commissioners while other copies also may be ordered by calling the above telephone number. Flood Insurance Study and Flood Insurance Rate Map finalizations will allow for lower flood insurance rates for current and future developments in less hazardous areas.

### Element 3.2

Work with county in developing a workable floodplain management ordinance. On March 26, 1984 the county passed ordinance number 1984-2 which provided a four-month moratorium on the issuance of building permits within a floodplain. This four-month period has passed without further action so the moratorium is lifted; development is subject therefore to the conditions of the below noted existing policy ordinance. A new floodplain ordinance has been submitted to the county commission for their review. The new floodplain ordinance would take the place of the county's April 28, 1980 policy ordinance to take limited control of development within floodplains and would provide a stricter control of development on floodplains. For example, for development within the floodplain the first floor of new construction will be required to be at least at or above the 100-year flood level. (As previously noted, a basement is the first floor.)

Some form of this new ordinance will be required within the period of six months after the local review and appeal process is completed on the draft Flood Insurance Study and accompanying maps (see element 3.1). Without an updated ordinance, FEMA sponsored flood insurance and most real estate financial sources would not continue to be available in the county outside of incorporated areas. The review by the county commission of the flood insurance study and map is expected to be completed by September 1985, so the ordinance adoption deadline is expected to be in March 1986.

The county commission is encouraged to adopt an updated floodplain ordinance now and not wait until the March 1986, deadline in order to prevent the placing of the first floor of current new construction below a base flood level. The high hazard area category described in element 2.1, 2.2, and 2.3 should be an included category. Guiding the building of facilities such as the Imperial Apartment complex ~~OR~~ the Salmon River Campground within known flood areas will save money for county residents as well as for potential property owners within the floodplain.

### Strategy #4 - Remove Ice or be Prepared to Fight the Flood Caused by the Melting Ice

#### Elements 4.1 and 4.2

Research methods of financing ice removal. On March 22, 1984 FEMA, subsequent to its original declaration, added public assistance as an eligible aid category. With this action, the removal of hazardous buildups of ice was undertaken by

the city of Salmon with 90 percent FEMA-State reimbursement.

#### Strategy #5 - Community-Wide Responses to Reducing Future Flood Damages are to Continue and Increase in Intensity

##### Element 5.1

The state of Idaho, the city of Salmon and Lemhi County are to work with the Corps of Engineers in developing and implementing a solution to more permanently reduce damage to existing properties.

Alternatives considered in the Corps' Flood Damage Reduction study are:

- Levee construction and re-enforcement within the city of Salmon. (Significant local/regional cost sharing will be required for raising bridges and right-of-way easement purchase.)
- Floodproofing existing properties at risk with federal funds and cost-sharing using local/regional funds. This could include a levee construction to protect particular higher cost property such as the Imperial Apartments.
- Dump Creek-Salmon River fan dredging in order to reduce ice jams.
- Rely only on individual remedial efforts.

The removal of the Salmon River blockage at Dump Creek is not expected to give relief from ice jams in the most severe winters; however, it will give some relief in most years to agricultural land ice-jam flooding as well as relief from high water in the river areas of the city of Salmon. This agricultural land relief is generally not available from the less total cost and more economic city of Salmon levee alternative.

The past COE recommended plan, because of the cost and benefit relationship, has been the medium expenditure (option 3) levee construction alternative. The public has given a mixed response to the plan. The COE in November 1984 looked at some different aspects of the channelization alternatives in an effort to reduce the costs and environmental impacts while keeping the project near the same effectiveness level. The Corps also has looked further at the levee alternative. Under current law for the levee alternative, the city of Salmon or other local regional sponsor would have to provide about one-third the costs or \$570,000 of the \$1,500,000 project, yet with the dredging/fill alternative, the maintenance costs are significant. The result is with low or no interest financing of the local-share construction costs, the total local net cost over time of the two prime alternatives is somewhat equalized. In the table on the next page is given a summary listing of cost and benefits of these two further analyzed alternatives.

The time appears to be nearing when the decision will be made on which approach to use for a more permanent solution. This decision should be made by July 1985. Implementation of the decision will follow. The lead agency for the State is designated as the Idaho Department of Water Resources; the responsible person is the operations bureau chief.

In a related aspect, many local people would like to see the Department of Water Resources take a more central role in working on a long-term solution to the flooding. Some western states have a significant state water planning effort to reduce flood damages. Other western states have a much smaller water planning effort and rely largely upon the Corps of Engineers to work directly with the local people. Idaho's water planning funding has been low so the last approach generally has been used. The local people have not been satisfied with this in their case. They feel even with limited Department of Water Resources funding, closer coordination on a long-term solution was needed even though it would take a person away from other tasks. Whatever the case, the initial recommendation of this element 5.1 is still most important; that is, all the above-identified parties are to work for and expend time to develop a more permanent solution for the flooding problem. The extraordinary past efforts of the local people which has included using their own consultant should not stop for the alternative of relying only on individual remedial efforts appears as the least desirable alternative.

##### Element 5.2

Place 1984 flood-level vandal resistant markers in strategic and prominently visual parts of past flooded areas in the City and along the Salmon River in river flat areas on county road property. See figure 8 for examples.) To make the signs

resistant to removal, a steel post should be used and the sign should be welded or otherwise attached to the post.

Along the Salmon River in the county indicate the highest level of historical flooding on the markers.

County priority areas could include the following locations:

1. along the sewer plant road
2. Big Flat along the river access road
3. Wagonhammer Spring Campground
4. the river access road one mile north of Salmon
5. along Williams Creek Road near the crossing of the Salmon River
6. at end of road to Salmon River at north end of airport
7. at Carmen along U.S. 95 (if flooded in the past, otherwise, mark as "flood-prone level")

City priority areas would be:

1. in River Street area (2-3 signs)
2. north St. Charles Street
3. along Confederate Drive (2-3 signs)

It has been suggested that an effective proposal to inform people of flood levels would be some type of buyer notification be used to inform buyers that a flood-prone piece of property is located within a floodplain. This notification idea has merit in many cases. One way of implementing the proposal is by recording a notification on the county recorder's records that all or a significant portion of the subject property lies within a floodplain. The assessor's office would develop the list of property owners. This recorded information then would appear on the preliminary title report that a buyer receives sometime before he finalizes a purchase.

Current notification generally occurs when the loan officer calls to tell the buyer he must arrange flood insurance if the property appraiser notes that the property is within a floodplain and if there are buildings on the property. Many appraisers only note property in floodplains if Flood Hazard Boundary Maps (FHBM) have been prepared by FEMA. The Flood-Prone Area Maps prepared earlier by the U.S. Geological Survey are the only available maps in many areas and may not be consulted. Lemhi County will have Flood Hazard Boundary Maps by the end of the year so after that time many advantages for the proposal will be passed for purchasers with arranged financing. The proposal still would make the appraiser's job easier and less subject to error and, perhaps more importantly, the proposal would give notice to contract-sale buyers, to other types of owner-financed buyers, and to purchasers of vacant land. Thus, the county commission should give this recording proposal further discussion.

The recording of floodplain information will not provide information to short-term property users such as renters. It also will not provide information to buyers until after their decision to acquire a property has been made, a decision many buyers may be hesitant to change just before they are to sign the purchase documents. For this reason, the installation of a few low-cost, flood-level markers as indicated above is recommended in order to ease later pressure for variances. Outside the city of Salmon the county commission, perhaps through the county highway department, would be the lead for implementation. Within the city of Salmon the city council, through the city administrator, is the suggested lead. The two administrative bodies should review and decide by the end of July 1985, on whether to pursue the marker proposal.

### Element 5.3

Evaluate potential state floodplain management act. The Idaho Department of Water Resources evaluated a potential state floodplain management act in conjunction with its administration of parts of the federal flood insurance program in Idaho. The potential state act at this time is believed to potentially cause significant state duplication of FEMA mapping and related FEMA work with the counties. The act would require a significant state administrative expenditure or considerable economic development could be held up pending state approval from a limited staff.

### Element 5.4

Federal and state agencies are to work closely with the city and county officials in future disaster actions and provide added outreach efforts for individuals hesitant to contact government agencies. Different aspects of this recommendation relate to hazard mitigation, generally in the indirect manner of providing funds for mitigation and related activities. The

recommendation is from the viewpoint of the local client, while also it is intended to be positive and program strengthening. Subsequent action suggested below should take place during 1985.

8. With the disaster declaration, out-of-town teams and representatives come into an area for each agency with significant responsibilities. Many procedures have been established for each of these agencies; however, the many aspects of local problems are overlooked in the rush of the agencies to complete their assignment in a timely manner. Some available procedures are not used but are needed in a particular local situation. It is recommended each involved -agency in diaster follow-up take the leadership to schedule periodic meetings with a city and county representative to re view with them a list of people helped , the general nature of the use of the money involved as well as the general direction their agency program is going and related problems. Certain details of individuals' business and financial statements are not to be made public, however the list of money disseminated to individuals appears to be public information, just as each individual state employee's salary is public information.

Through this local review, some needs that still need to be met can be brought out, discussed and acted upon. An administering agency may feel that it is fully effective, yet when outside input is added, a stronger program generally results for the benefit of the public as well as for the benefit of the agency. This increased contact and working with local officials is an attempt to increase the positive image of both the Idaho Department of Health and Welfare and its Individual Family Grant (IFG) program and the Idaho Housing Agency and their programs. SEA and FmHA programs also would be benefited by this additional contact. The coordinator of the Idaho Bureau of Disaster Services should meet with the state agencies to encourage this policy. Likewise, the Regional Director of the FEMA should pursue this recommendation with his regional federal agency counterparts and with the national FEMA office.

It also is recommended that the primary local contact be with the major local representative government (that is, county or city). For example, FEMA in establishing rural problems met directly with officers of the local soil conservation district. The county commissioners, however, knew of particular needs that were not met until much delay had occurred.

9. As part of this process of trying to reach the local people by the out-of-town agencies, the agencies must also actually complete the process. That is the eligible and interested inquiring individuals are to be brought into the applicable programs. The problem is the average local person does not understand the agency's procedures and may be intimidated easily. Several people have not followed *through with* the proce dures the particular agency sets or have not used the procedures to serve their needs. These individuals feel lost and feel that they have no one to turn to that they feel can help them.

It, therefore, has been and is recommended as part of the disaster procedure, the out-of-town agency, such as the SBA, appoint a local relatively knowledgeable person as an ombudsman to work with the local people. This ombudsman may be used by more than one agency. He could be used to guide the applicant to the proper agency or work with two or more agencies to fit the applicant into one program where the applicant's case may borderline between programs. The ombudsman would act as a quasi-appeal board. It is stressed the ombudsman be a local person so that the applicants will make use of him and the ombudsman will more understand the needs to be filled. The Associate Director of State and Local Programs and Support of FEMA in Washington, D.C. should undertake discussion with the appropriate SBA manager in order to encourage this policy.

10. Related to working with individual applicants is the desirability of some improvement of the outreach program to bring in eligible people that have a real need but are hesitant to become involved with a government agency. This need pertains particularly to the IFG program of FEMA which is handled by the Idaho Department of Health and Welfare. The local welfare office administered the IFGs. It was reported people associated such a welfare stigma with that office that they would not go in to discuss legitimate needs. In a legitimate attempt to respond to public criticism where it can be done economically, the following recommendation is made. It is recommended in future disaster declarations, the initial IFG applications and administration be handled in the central disaster office if one is designated or in an office in the nearest city hall.
11. In a somewhat related matter, some local people had the perception that some local welfare employee(s) projected somewhat of a negative attitude toward the needs of IFG applicants. Many of the legitimate applicants were not regular Department of Welfare clients so some assigned caseworker(s) subconsciously may have viewed wrongly the applicant as not meeting welfare criteria. It was stated some applicants for SBA loans were turned down because of having marginal potential for repayment, yet they were rejected from the IFG program as having excessive resources for a grant. It appears the intent of the FEMA criteria for the state administration of the IFG program is if an applicant is turned down by SBA that he has automatic qualification for the IFG program. Some slight adjustment

of the IFG criteria may be needed. A representative of the coordinator of the Bureau of Disaster Services should further discuss these criteria with the IFG program leaders.

12. Other agencies also must be mindful of the outreach responsibilities. In federally declared disasters with the resources of all applicable government agencies involved, as well as in a federal-state emergency where only selective federal agencies may be involved, the many affected agencies should increase their outreach efforts significantly over those used in their regular programs. In rural areas, an increase in the outreach efforts done by the Department of Agriculture will give added benefit. The Department's agencies include the Farmers Home Administration, the Soil Conservation Service, and the Agricultural Conservation and Stabilization Service. many times agency outreach efforts are quite good; at other times increased attentiveness to the need with a small increase in effort can yield a much greater benefit to the agency's clients. The Regional Director of FEMA should discuss this need with appropriate state directors of the USDA agencies at the time of the next disaster. Preliminary discussions also may be in order.

#### Element 5.5

Provide mechanism for a very heavy and immediate equipment response to levee (bank) overtopping. At Salmon local residents appeared to make an extraordinary response to the ice flooding.

The warning and evacuation level of work done appeared most prompt and thorough. Local attempts to control the flood also were considerable. The parts of this recommendation are made in order to encourage a continued effectiveness of the local effort in order to contain as much of the potential disaster as possible.

This recommendation consists of four important elements. Each part is in reality a separate recommendation and should be acted upon as such. In each case, the operations and training officer for the Idaho Bureau of Disaster Services will need to work with the county civil defense director during the current year of 1985 and subsequently.

- A. The Idaho Bureau of Disaster Services is to give local civil defense directors continued training in working under the most adverse weather conditions with contractors and city/county maintenance personnel.
- B. Preliminary meetings with contractors are to be undertaken by local civil defense directors to provide mutual knowledge of problems with rapid mobilization. These meetings should be repeated on two-year intervals.
- C. A list of potential general superintendents available for selection by the county civil defense director is to be kept current by the county civil defense director and monitored by Idaho Bureau of Disaster Services.
- D. The Idaho Bureau of Disaster Services is to make sure local civil defense directors have immediate access to extensive lighting equipment for night-time work. One source might be the local district highway department. Civil defense directors should check out other sources.

# APPENDIXES

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## Appendix A

### Hazard Mitigation Planning Team Participants 1/

<u>Participants</u>	<u>Entity</u>
Ralph Mellin	Idaho Department of Water Resources
Clark Meek	Idaho Department of Disaster Services
Robert Freitag	Federal Emergency Management Agency
Polly Prchal	City of Salmon - City Administrator
Louie Demick	Lemhi County - Chairman of County Commission

Also attending a preliminary team meeting on April 4, 1984, were:

Neal James	City of Salmon - Mayor
Quinton Snook	Lemhi County Commission - Commissioner
Patricia Hauff	City of Salmon - City Council member
Vivian Withington	City of Salmon - City Council member
Glen Ford	City of Salmon - City Council member
Jack Nelson	City of Salmon - City Council member
Luke Prange	City of Salmon - City Council member

Different members than the earlier, largely federal, agency team that prepared the Interagency Hazard Mitigation Team Report (15-day report) makes up this hazard mitigation planning team. The federal Office of Management and Budget directed that the federal Interagency Report be completed within 15 days of Presidential Disaster Declaration. This Hazard Mitigation Planning Team Report follows the direction given in the federal Interagency Report.

# **Special Flood Hazard Information**

## **Salmon River Ice Jams**

From Dump Creek Upstream Through The City Of Salmon, Idaho

Prepared For  
Lemhi County, Idaho

February 1984



## SECTION 3

### MECHANICS OF ICE FORMATION AND FACTORS WHICH

#### CONTRIBUTE TO THE FORMATION OF ICE JAMS

##### 3.01. GENERAL.

The two major factors that contribute to ice jam flooding are the air temperature and the flow velocity once the ice cover has arched or bridged in the river. The meteorological parameters control the exchange of heat at the water surface in return for ice generation or solid-ice growth, while the flow hydraulics at the various sections control the ice thickening process. Further explanation will be made as the important meteorological and hydraulic parameters are discussed in relation to the Salmon River.

##### 3.02. TEMPERATURE.

Air temperature seems to be one of the most important meteorological parameters that contribute to the development of ice jams in the Salmon River. Once the river water reaches its freezing point and sub-freezing air temperatures occur, large quantities of ice, commonly called "slush" or "frazil ice", will be produced in the open water. The slush flows downstream and forms the ice cover. This process will be explained in more detail later in the report.

The many hot springs above Salmon and the warm waters of Pahsimeroi River will at some time influence water temperatures (and ice production) at Salmon.

##### 3.03. FLOW VELOCITY.

The flow velocity affects both the type of ice formed and the mechanism of ice-cover accumulation. When the velocity is less than 0.5 fps the lateral ice growth from the shore grows fast to cover the water surface. Ice floes traveling downriver also can contribute to the lateral ice growth development.

For water velocities in excess of 2.0 to 2.5 feet per second the lateral ice growth is slow, and the ice cover will not span the river width under the same mechanism as when the velocity is less than 0.5 foot per second. In these open-water reaches, frazil ice is formed which develops into frazil pans and anchor ice. This frazil ice often constitutes part of the downstream 'lateral shore ice.

Frazil ice is generated only in turbulent open-water areas of the river when the water temperature is a few hundredths of a degree below its freezing point. The dominant meteorological parameters that contribute to the heat loss from the water surface are long-wave radiation, convection at the water surface, and evaporation; i.e., clear nights, air temperature less than -15 Fahrenheit, high wind velocity, and low relative humidity.

Frazil ice, which does not become attached to some objects in the channel, accumulates into small clumps called "flocs" which float to the surface. These flocs continue to grow, forming clumps or balls of slush ice, then ice pans, which eventually grow large enough to be called ice floes. During cold weather, when the temperature remains well below freezing, the Salmon River may be filled with clumps of slush ice.

When the ice cover finally bridges at a cross section and the leading edge begins to progress upstream, the flow hydraulics just upstream of the leading edge, as well as beneath the ice cover, have changed completely compared to the open-water conditions without ice. The thickness of the advancing leading edge of the ice cover depends upon the flow velocity and depth, roughness coefficient of the ice, and the meteorological conditions.

If hydraulic conditions are reached in which the ice cannot progress upstream, it merely travels beneath the ice cover and deposits in a low-velocity area. Continued deposition will create a rise in the water at the leading edge, lowering the velocity until the ice cover can progress upstream again. The water level reached by the flow in the river during ice-cover formation may exceed the channel capacity and some of the flow may escape into the flood plain.

During breakup or when the flow discharge increases, the initially thick river ice cover restricts the flow and causes overbank flooding. In addition, the cohesive bonds that helped the ice cover freeze up are now disappearing, and the jam will

thicken to greater values during the periods when the air temperature rises above freezing.

#### Geographic Locator

Name	Location
North Fork	23 miles downstream from Salmon
Dump Creek	5 miles downstream from North Fork
Deadwater	4 miles downstream from North Fork
Red Rock	112 miles upstream from North Fork
Fourth of July Creek	5 miles upstream from North Fork

#### SECTION 4

#### AN ANALYSIS OF TYPICAL ICE JAMMING CONDITIONS ON THE SALMON RIVER

##### 4.01. THE FORMATION AND GROWTH OF A FREEZEUP JAM.

A typical freezeup ice jam along the study reach will begin with a drop in the air temperatures in Salmon to below freezing during the day and near zero at night. Since a drop in Salmon temperatures is often preceded by a drop in temperatures in the upper basin a day or two earlier, slush ice may be seen in the river almost immediately. Shore ice will begin to form along the river at points where the current is sluggish, such as the northeast shore of Fourth of July Creek Access, Red Rock, and particularly at Deadwater.

During the winter low-flow season the backwater effects from Dump Creek extend upstream to a point about 2,000 feet above Deadwater Campground. Following the current downstream through this point, the flow regime changes abruptly from the shallow, rapid (7.2 fps) flow over the gravel foreset to the deep, tranquil flow of the Deadwater reach. Shore ice growing out from the streambanks can link up with frazil slush moving downstream to rapidly form a solid cover in this tranquil reach. Once the cover has formed, slush ice can rapidly collect under the ice cover, forming an obstruction called a "hanging dam." A hanging dam, formed in the tranquil reach downstream of the gravel foreset, probably initiates the major ice jams which build upstream through the City of Salmon, Idaho.

As the flow area under this dam is progressively reduced and the velocity increases, an equilibrium is eventually reached in which the velocity is high enough to carry all of the frazil slush under the dam, preventing further growth. Frazil slush is then carried under the dam and deposited further downstream. Eventually, much of the Deadwater reach may be filled with a mass of slush ice.

During the 1983 ice jam investigations, measurements indicated that the channel cross section across from Deadwater Campground was essentially filled with frazil ice. Depths of ice in excess of 16 feet were measured. Forest Service personnel also noted that the center of the channel in the lower portion of Deadwater remained open for some time after the upper half froze across. This was apparently due to ice starvation; a condition in which all of the frazil slush was being trapped and deposited into the cover upstream. However, during a long, cold period the shore ice will eventually build out to the center of the channel, resulting in a continuous cover over the entire Deadwater reach. Frazil slush may then fill in much of the space under the cover.

At the upstream end of Deadwater, the depth of flow will increase due to the hanging dam obstruction. Then ice pans and loose masses of frazil slush moving down the river will slow and consolidate by thickening at the leading edge or by internal shoving, resulting in the upstream growth of the ice jam.

While the leading edge of the Deadwater jam is growing upstream, shore ice will continue to build out from the shoreline and islands upstream. Fourth of July Creek access and Red Rock are reported to bridge over before the arrival of the leading edge of the main jam and may produce a cover several hundred feet long. Soundings and velocity measurements made at Fourth of July Creek access in 1983 indicated that the velocity was less than two fps except for a 17-foot-deep channel around the face of the rock where the velocity approached three fps. Apparently the velocity in this portion of the

channel remains high enough to pass most of the frazil slush and delay the formation of a serious jam. However, when the Deadwater jam reaches this point the backwater effect slows the current and the jam progresses through this reach.

The degree to which the channel can be filled with ice is illustrated by Plate 4, which was based on measurements taken during January 1983. Other measurements indicated a depth of frazil ice in excess of 16 feet opposite the Deadwater Campground, nearly 12 feet at the Forest Service Bridge, and 10 and 9 feet, respectively, at the next two bridges upstream. The ice caused a rise in the water surface of from about six feet opposite the Deadwater Campground to about nine feet at the second private bridge upstream of North Fork.

Ice jams are known to occur at locations outside the study reach. Reports from residents indicate that the river freezes across at a number of locations between Dump Creek and Pine Creek Rapids, 17 miles downstream from Dump Creek near Shoup. It is probable that the storage of ice in the channel upstream of Dump Creek significantly reduces the severity of ice jams for some distance downstream.

#### 4.02. FLOODS RESULTING FROM INCREASED DISCHARGE AND ICE-COVER BREAKUP JAMS.

Based on a review of U.S. Geological Survey (USGS) discharge records, it is not uncommon to have a relatively large rise in discharge prior to the breakup of an ice jam. This situation occurred during the 1943, 1963, 1974, 1979, and 1982 ice jams and, probably, several others, which occurred earlier. Since an increase in discharge is usually accompanied by a warming trend, the water will begin to melt the ice (especially along the shore) and the cover will begin to weaken. Eventually the ice cover will break up and shove downstream. The jumbled mass of broken ice may block the river by jamming at obstructions such as islands, sharp bends, or more-resistant sections of the downstream ice cover. Considerable flooding occurs as the water seeks other paths of flow in the flood plain adjacent to the river. Although the winter discharge is typically in the 1,000-1,500 cfs range, the depths of flooding may be equivalent to a spring flood of 15,000 cfs or more. See Table 1, page 4-6.

When the jam washes out it often cuts a channel through the center of the jam, leaving large quantities of ice along both shores. This ice may remain all winter. Successive ice jams during the same winter will move more rapidly up the channel.

#### 4.03. TEMPERATURE STUDIES RELATING TO ICE-JAM GROWTH.

A study was made in an attempt to correlate ice conditions with local air temperatures in the study reach. During a cold period air temperatures in Stanley may be as much as 20 degrees colder than Salmon, while temperatures at Challis (63 miles upstream) generally differ only by four or five degrees. Since cold periods in the upper basin are nearly always associated with corresponding cold periods in the study reach, Salmon temperatures were considered representative for analysis purposes. Challis temperatures were used during some years when Salmon records were missing.

Average daily temperatures during each cold period from 1894 to 1983 were analyzed to see if a correlation could be found between severity of the cold period and the formation of a jam extending upstream to Salmon. Plate 8 indicates the accumulated freezing degree-days during the coldest periods for each year. The circled points indicate when the cold period was severe enough to produce a jam, which extended all the way from Dump Creek to the city of Salmon. Note that jams nearly always reached Salmon when the accumulated freezing degree-days (in OF. below a 32OF. base) exceeded 400, while jams, seldom reached Salmon when the total was less than 300.

The condition of ice and the progress of the upstream edge of ice jams were monitored by the Forest Service during the winter of 1982-1983. The results of these data, along with ambient temperatures, were plotted on Plate 6. Based on these data, it appears that an ice jam generally will not progress upstream if the mean temperature is greater than 22 degrees Fahrenheit. Minimum daily temperatures during the upstream growth of an ice jam generally drop below 0 degrees Fahrenheit each night.

Using data from years when the upstream progress of the ice jam was known and the cold weather was relatively constant, it was found that the ice jam progresses upstream at an average rate of one mile for every 8.8 degree days below a 22 degree Fahrenheit base. Of ten several ice jams will form during a single winter with large quantities of ice remaining along each shore after the jam washes out. Under these conditions (depending somewhat on the intervening temperatures between ice jams), fewer degree-days may be required for the upstream progress of each succeeding ice jam.

As an example, if the daily minimum and maximum temperatures were -20 degrees Fahrenheit and -0 degrees Fahrenheit, respectively, the ice jam would move upstream at about 3.5 miles per day, requiring about one week to reach

Salmon, Idaho.

#### 4.04. HISTORY OF ICE JAMMING IN THE VICINITY OF SALMON.

What is presently known of the history of ice Jamming is based on a search of all available newspaper reports, several published historical accounts of the region, interviews with long-time residents of the area, weather records, and river-stage and -discharge records. Unfortunately, nothing is known about ice conditions prior to the formation of the Dump Creek alluvial fan.

Streamflow records were relatively sketchy up to about 1920. However, weather records in 1899 listed temperatures during a six-day period, which were cold enough to produce a jam reaching all the way to Salmon. Newspaper reports also indicated significant jamming downstream of Salmon during the winters of 1903, 1904, and 1908; and a major jam, which reached Salmon in 1910.

Table I lists the jams which have been severe enough to cause a noticeable rise in water surface at the USGS gage in Salmon, Idaho. Data for the years 1899-1919 are based primarily on weather and news reports, while the remainder are based on USGS stage records.

The data on Table 1 indicate that the highest recorded stage (9.62 feet) occurred in 1942. The longest period of jamming (nine weeks) was also experienced this year. It is interesting to note that local newspapers reported more serious flood damage in 1943 than in 1942, although the 1943 jam apparently did not quite reach Salmon. Chinook winds in 1943 melted snow in the mountains, causing a sudden increase in discharge accompanied by serious flooding in the Big Flat area and blockage of the highway.

A jam in 1973 was almost as high as the 1942 jam (9.60 feet). Other long periods of jamming in Salmon occurred in 1939 and 1922.

Ice jamming is not limited to the study reach. Early flatboaters attempting to float the river reported ice blockages at scattered points for a long distance down the canyon from Dump Creek (Carey, p. 26; Bailey, pp. 433, 435). An ice jam was reported to have blocked the road about a mile downstream of the Indianola Ranger Station in 1963. This area jammed again in 1979. Newspapers reported that the water backed up high enough to seep into the Ranger Station basement. Other reports mention blockages at Corn Creek, Horse Creek, Fawn Creek, Lantz Bar, and Devils Teeth Rapids.

Newspapers reported ice jams at Challis in 1947 and 1966. The 1947 jam was severe enough to block the highway for a time. During field investigations in 1983 an ice jam about two miles long was observed between Challis Creek and Fuller Gulch.

#### 4.05. ICE JAM FLOOD FREQUENCIES.

The most reliable historical data on ice jam floods are based on USGS river-stage records. Although these data are strictly applicable only at a point about 0.5-mile downstream of the Salmon River Bridge where the gage is located, they do provide a reasonable indication of severe ice conditions downstream. Ice jams were assumed to have reached Salmon if there was a cold period accompanied by a rapid increase in stage, which could not be explained by an increase in discharge. During the 73-year period from 1910 to 1983, ice jams reached Salmon on about 25 of these years, with jams occasionally building up to Salmon twice during a single winter. It is interesting to note that these jams had an average recurrence interval of 1.7 years from 1871 to 1940, 4.3 years between 1941-1970, and 2.6 years from 1971 to the present. The overall average recurrence interval was 2.96 (a probability of about one chance in three that a jam would reach Salmon, Idaho, during a particular winter). The probability of reaching a given stage during a single winter and during a winter when an ice jam reaches Salmon is indicated on Plate 5.

Ice jams have occurred and have caused major flooding downstream of Salmon during other years than these indicated above. A study was made of weather records from 1899 to the present, comparing them with weather conditions during the winter of 1983 when ice-jam growth was closely monitored by the Forest Service. Based on the weather records, ice jams severe enough to reach North Fork have occurred during about nine out of every ten years. On the average, ice jams of this severity have occurred two times each winter, with jams moving up the river as many as four or more times during some winters.